Notice on Consultation Paper

In the process of development of general guidelines with a view to adopt safety norms and precautions while erecting antenna structures, and to protect/ensure health and safety of the general public and occupational personnel as well as to maintain beauty of the city skylines, Nepal Telecommunications Authority has prepared a consultation paper entitled **"NTA Guidelines on Erection of Antenna Structures and Protection from Non - Ionizing Radiation from Radio Base stations"**.

This notice is published with a view to receive feedback from the concerned stakeholders as well as from the professionals, experts and any other interested parties on the various issues raised in the consultation paper. The consultation paper is available on NTA's website (www.nta.gov.np). You are kindly requested to provide your valuable comment/suggestions in the following address not later than 26 March, 2010.

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CONSULTATION PAPER

NTA GUIDELINE

On

ERECTION OF ANTENNA STRUCTURES AND PROTECTION FROM NON-IONIZING RADIATION FROM RADIO BASE STATIONS

Nepal Telecommunications Authority

February, 2010

TABLE OF CONTENTS

Annexure -VI International Recommendations on safety issues

List of Abbreviations and Definitions

AMSL	- Average height over Mean Sea Level
Antenna	- Radiating elements, used for radio communication
BTS	- Base Transceiver Station
CAAN	- Civil Aviation Authority of Nepal
EMF	- Electro-Magnetic Field
Height	- Height from ground level
HT	- High Tension Line
ICAO	- International Civil Aviation Organization
ICAO Annex-14	- Guidelines prescribed by ICAO on obstructions around aerodrome
ICNIRP	- International Commission on Non-Ionizing Radiation Protection
ITU	- International Telecommunications Union
IO	- Infrastructure Owner
Mast	- A metallic structure, self-supported, guyed, or monopole type
MOIC	- Ministry of Information and Communication
NTA	- Nepal Telecommunications Authority
Owner	- Owner of the mast or structure
RF	- Radio Frequency
SPD	- Surge Protection Device
Structure	- A tower, platform or metallic structure where radio antennas could be mounted
Tower	- A structure that is designed and constructed for supporting one or more antennas
TSP	- Telecommunications Service Provider
TVRO	- Television Receive Only
WHO	- World Health Organization

1.0 INTRODUCTION

Preamble

Growth of mobile telephones has led to haphazard expansion of the BTS infrastructures in the urban areas. Operations of FM radios, wireless internet networks and TVRO dishes have further contributed in erection of radio masts and various metallic antenna structures on the rooftops of the cities. This situation is more prevalent in the urban areas of Nepal due to absence of appropriate binding laws or guidelines. Therefore, most of the city skylines in Nepal have rapidly turning into junk of metallic structures, which, if not regulated in time, may lead to serious environmental as well as disastrous consequences in the future. Tower erection guidelines already exist in the developed countries and many of the countries in SAARC region. In Nepal, so far there is no Government regulation or National Policy governing fabrication and erection of antenna masts. Therefore, any unforeseen natural calamity resulting in collapsing of rooftop masts in public areas may cause human casualties and destruction of public/Government properties. Haphazard construction of masts is also leading to various environmental issues. In addition, there is no provision of insurance or compensation safeguarding the public and property from such calamities. Therefore, on 6/08/2065, the Nepal Telecommunication Authority formulated a technical committee to prepare general guidelines on erection of antenna masts in Nepal with a view to assisting the service providers to adhere to international norms and safety precautions while constructing the antenna masts. While compiling the guidelines, NTA has mandated the committee to accommodate best international and regional practices on the erection criteria of the communication masts. Based on the report of the committee, NTA has prepared this consultation paper in order to receive the relevant comment/suggestions in the respective field.

Purpose

The purpose of this Technical Guidelines is to assist the telecommunications service providers to observe uniformity and safety norms while erecting antenna structures and to protect health and safety of the general public as well as to maintain beauty of the city skylines. It is not intended to interfere or harass Telecom Service Providers (TSPs) in their expansion program or intervene in existing agreements between parties or already installed and operational sites. While preparing these Guidelines, the following references are considered in these Guidelines:

1. Criteria related to siting and erection of antenna masts and supporting structures observing the environmental degradation and safety issues.

2. Identifications of antenna masts and structures by types of services and visual obstruction paintings as per ICAO regulations.

3. Non-ionizing RF Radiation and safety guidelines around the public dwellings near or vicinity of the antenna towers.

4. Any other relevant issues

2.0 GUIDELINES ON ERECTION OF ANTENNA STRUCTURES

2.1 Approval Process

All towers and associated structures, meant for telecommunications purposes and installed within the territory of Nepal, must comply with local safety and urban development requirements and adhere to the guidelines suggested in this document. Therefore, prior to installing any kind of telecommunication antenna structure, NTA approval must be obtained. By issuing this "NTA Guidelines on erection of antenna structures" it is not intended to harass or intervene the TSP in their expansion works. The antenna masts and the associated radiating elements are directly related to public safety, aviation safety, health hazards and aesthetic values of the urban areas. TSP!IO shall initiate for NTA approval as follows:

1. These guidelines are intended for Telecom Service Providers (TSP) and future Telecom Infrastructure Owner (IO) only, which are under the jurisdiction of Nepal Telecommunications Authority.

2. All TSP and IO, expanding their services in Nepal, shall be obliged to fill a "Declaration Form", as detailed in Annexure-I of this document. This would enable NTA to keep records of all radio transmitting sites used for telecommunications purpose as per ITU requirements.

3. Towers shall be designed and constructed in compliance with technical requirements provided in these guidelines.

4. After the receipt of Declaration Form, NTA will issue an "Approval Letter" to commence construction and erection works as detailed in Annexure-II.

5. No telecommunication antenna structure shall be constructed without receiving an Approval Letter from NTA.

6. After the completion of erection work TSP! IO will have to submit the completion report as detailed in Annexure – III.

7. If a site is close to an aerodrome or in the vicinity of the aerodrome or on the air-routes, a prior clearance from CAAN must be obtained by TSP!IO before submitting the "Declaration Form". The location of the aerodromes and the air-routes could be obtained from CAAN.

8. To safeguard the public from possible physical damage of the antenna structure due to any natural calamity or its faulty workmanship, a minimum third party insurance coverage of a single or group of antennas must be taken by the service provider before commencing the construction works.

9. Where possible TSP shall avoid installation of large base stations close to schools, hospitals and archeological or national heritage sites.

10. All TSP!IO are requested to submit the site details of all the base stations installed prior to issuance of these guidelines such that NTA would have the updated data base of all the radio base stations.

2.2 Mandatory Restrictions

2.2.1 Vertical Heights

1. Maximum height of any antenna tower or structure from ground shall be within the limit governed by the recommendations made by CAAN, local municipality and urban planning of Nepal.

2. TSP/ IO should exercise caution while designing the height of an antenna tower close to airport area. Airspace around aerodromes, approach path and landing areas are very critical and must remain free of obstacles to permit safe aircraft operation. Therefore, all towers must meet current standards and recommendations specified by CAAN, which are largely based on ICAO Annex-14 guidelines. A summary of CAAN guidelines with respect to allowable heights of physical structures in the vicinity of aerodromes is provided as Annexure -IV to this document.

3. If prevailing standards and regulations are changed by CAAN to enhance flight safety, then the owners of the towers and antennas, governed by this Technical Guidelines, shall bring into compliance as soon as practicable, but not exceeding six (6) months from the date of such revision. Failure to bring towers and antennas into compliance with such revised standards and regulation shall be liable for removal by CAAN at the owner's expense.

2.2.2 Electrical Safety

Hundreds of fatal accidents and deaths do happen all over the world while attempting to install or dismantle antennas and masts in the urban areas. In most of the cases the victims were found aware of hazards and consequent electrocution, but no adequate precautions, with respect to vertical or horizontal separations, were taken into account. Therefore, following precautions shall be taken by TSP/IO while selecting a site or designing an antenna structure closer to High Tension Lines.

1. Avoid installing masts close to a power line, where practicable.

2. Height of the tower and masts should be restricted to half of the distance between the proposed site and HT Line.

3. Observe the local municipality regulations. Local municipalities have their own restrictions for all types of constructions close to HT Lines.

2.3 Design and Erection Criteria

2.3.1 Qualification of the Designer

1. To ensure structural integrity of towers, the owner of the tower shall ensure that it is designed by a qualified registered structural engineer by adhering to standards and codes applicable by the Government of Nepal or prevailing international standards.

2. Upon inspection by NTA if it is verified that a particular tower fails to comply with safety standards and pose danger to property or persons, then a written notice shall be served to the owner of such tower. A corrective action shall be taken within 30 days from the receipt of such notice. Failure to comply shall be subject to removal of such tower at the cost of owner.

3. All antenna structures with height exceeding 30m shall be designed and detailed as post-disaster type structure. Design of such structures must be certified by a registered structure engineer and made available to NTA prior to construction.

4. Where similar tower or antenna structures are used repeatedly, such as for BTS, it is recommended to provide drawings of the antenna structures to NTA. This would enable NTA to recognize the type of antenna structure to be built and would expedite approval process without delay.

2.3.2 Installation at Ground Level

1. Height of an antenna structure on ground shall be limited to the ICAO obstruction criteria. General guidelines on height restrictions at various distances from an aerodrome are indicated in Annexure-IV of this document. However, TSP/IO are advised to consult CAAN prior to making any decision on high-rise towers, especially in the vicinity of an aerodrome.

2. The installation of the antenna and antenna structure shall also be in compliance with specified guidelines of the local municipality and its site plan must be approved first prior to applying to NTA for getting approval.

3. If the structure is to be constructed in a rented or leased land, the property owner shall provide written authorization allowing such construction with specified time-frame of the lease.

4. The land should have adequate safety zone based on set back requirements of the structure to safeguard the general public and surrounding property from possibility of collapsing during unexpected natural calamities.

5. All high structures shall be designed by the certified structural engineers and fabricated only by the registered firm with adequate experience in tall structure fabrications.

6. All high-rise masts shall be mandatorily painted in White and Red (or Orange) colour pattern and lighted with non-glazing obstruction lights, as per ICAO requirements.

7. To prevent unauthorized entry to the antenna field it is mandatory to enclose the compound with a suitable fencing with clearly identifiable warning signs.

2.3.3 Installation on Roof-tops

Most of the communication base stations are located on residential buildings, which are not designed to facilitate heavy structure on their roof-tops. Therefore, prior to designing any high mast on a roof-top, structural integrity of the building must be observed very carefully. Structural drawings of the building must be examined to determine what further structural works would be required to accommodate heavy loads from a new structure. Based on above, following guidelines must be observed:

1. No antenna structure above 10m shall be constructed on public or private residential house roof-tops in the urban areas. The use of self supporting roof mount structures and monopoles will be preferred compared to Lattice or Guyed structures for the safety reasons.

2. Overall height of an antenna structure from ground (Height of the building + Height of the structure) shall be in conformity with ICAO obstruction criteria and should be limited to 45m from the ground. See Annexure-IV. The structure must be painted and obstruction lights should meet ICAO guidelines.

3. Any antenna structure from 5 to 10m would require certification from a Government approved structure engineer prior to submitting the Declaration Form and seeking approval from NTA. If antenna structures are less than 5m high detailed engineering design may not be required.

4. In exceptional cases where a structure over 10m high is required, it should be designed and detailed as post-disaster type structures and mandatorily certified by a professional civil engineer and/or a structural engineer.

5. Antenna structures on the roof tops must conform to Municipality norms and guidelines in this document. Where possible, preference shall be given to already existing towers rather than creating a new one close to it.

6. While planning a base station close to a national heritage site or in the restricted areas it is mandatory that the TSP/IO take a written permission from such authority prior to making a decision.

7. Towers/masts are attraction for lightning discharge. Therefore, it is mandatory to install "Lightning Protection" to protect household from possible lightning surge.

2.3.4 Qualification of the Fabricator

1. All approved structures shall be fabricated by the qualified fabricators; preferably Government approved registered firms, capable of welding and fabricating as per specified specifications in conformity with BS-8100 or other equivalent international standard.

2. Electric welding, gauge of the materials, galvanization and selection of other hardware shall meet design performance to withstand required wind velocity to prevent it from disintegration and damages to public and property.

2.4 Sharing of Antenna Infrastructure

During the last one decade, there have been significant experiments in mobile telephony infrastructure sharing amongst the mobile operators, seeking reduction in their financial expenditure. Now infrastructure sharing has become a popular venture all over the world, which not only reduces installation expenditure for the operators but also allows faster deployment of mobile services within a short span of time.

In Nepal, due to lack of coordination and mistrust, operators are expanding their infrastructure independently, which is not only time consuming and costly, but spoiling the city skylines and hinders fast expansion of network in the rural as well as urban areas. While, NTA must initiate coordinatory efforts to bring the operators closer to encourage them to share their existing infrastructure to each other, the operators should also realize the benefits of sharing, not jeopardizing the quality of service.

NTA encourages the TSP/IO to design and construct antenna structures to accommodate two or more operators to expand their services.

2.5 Lightning Protection

1. It is mandatory to install a proper lightning protection in any antenna structure whatsoever, whether roof-top installations or ground based installation, to protect the general public, household and equipment from this unpredictable natural calamity. No structure will be allowed to be constructed without proper lightning protection.

2. Annexure-V provides general guidelines on recommended lightning protection methods. TSP/IO are free to adopt any other method as long as it meets or exceeds the suggested recommendations.

3. Earth resistance should be measured at least twice a year to verify proper grounding requirements as specified in Annexure-V.

4. An insurance policy against damages due to lightning, at least third party, must be taken by the service provider to safeguard the public, household and the neighborhood where antenna structure is located.

2.6 Visual Markings

1. The markings and or lighting of an antenna structure are intended to reduce hazards to aircraft by indicating the presence of the obstacle. Therefore, it is mandatory to paint the large antenna structures and masts with proper visual markings as per ICAO recommendations.

2. All high antenna structures shall be colored to show alternating contrasting bands with orange and white or red and white colours with height or width of each colour segment not less than 1 .5m and not exceeding 3m.

3. An antenna structure less than 3m tall may be coloured with a single conspicuous colour red or white.

4. Occasionally, Flags may be used instead of color to mark the presence of an antenna structure. Flags used to mark the antenna structure should be orange in colour or combination of two triangular sections, one orange and the other white, and must be placed at the highest edge of the structure.

2.7 Mast Lighting and Obstruction Lights

1. High antenna structures or masts shall be lighted with high intensity red obstruction lights to show presence of an obstacle to the aircraft

2. It is strictly prohibited to make use of any portion of antenna mast or antenna structure for advertising, signs, festivity lightings, banners, company name, etc. However, an antenna mast may be allowed close to an existing advertising sign structure.

3. Warning signs and equipment information shall be permitted on an antenna structure.

4. An antenna mast should be lighted only for security and safety purpose. All such lightings should be shielded so that no glare extends substantially beyond the boundaries of the facility.

5. All masts over 10m high from ground and those located close to the airport area or on the approach path must contain obstruction lights as per ICAO regulations. No high intensity flood-lights or any other decoration lights of any kind, other than those recommended by ICAO, will be permitted.

2.8 Completion Report

1. Soon after completion of antenna mast or structure installation, isolated or in group installation, the service provider must send a completion report to NTA, as specified in Annex-III of this document.

2. NTA may conduct physical inspection of the site to verify structural integrity, workmanship, effectiveness of lightning protection system, RF emission levels and the matters related to safety and security of the general public.

2.9 Alteration to Approved Structure

1. Major initial or post installation alterations to an antenna structure, from what it was envisaged at the time of taking approval from NTA, must be done with prior consent from NTA.

2. All alterations that may affect structural integrity and safety of the antenna tower must be designed and certified by a Government registered structural engineer.

2.10 Removal of Abandoned Structure

1. Any antenna or tower that is not operated for a continuous period of 6 months, without giving any valid explanation, shall be considered abandoned. It is illegal to keep such antenna structure standing from the public safety point of view. TSP/IO shall remove such structure within 9 months from cessation of service or be liable for penalty.

2. If there are two or more users of a single tower then this provision shall not become effective until all users cease using the tower.

3. Prior to removal of any abandoned large structure, at least third party insurance must be taken to cover the risks of physical damage to the property or injury or death during the removal process.

2.11 Periodic Maintenance

1. The owner of the mast structures must carry out regular checks of the structures to ensure safety and integrity of the masts from corrosion and normal wear and tear.

2. The antenna structures shall also be inspected regularly to check Earthing resistance, maintenance of lightning system, operation of obstruction lights (if installed) and painting of the structures.

3. NTA, at its discretion, may visit a site with a prior notification to TSP, to ensure that all standards and guidelines prescribed in this document are complied by the service provider.

2.12 Change of Ownership Notification

Upon transfer of ownership of any antenna structure or tower to third party, the operator shall notify NTA and shall take prior permisiion prior to transfer formalities . The operator shall notify NTA if the rented land and/or house/structure ownership is transferred, within 30 days from the conclusion of the formalities of the transfer .

2.13 Security Fencing/Anti-climbing Device

It is hazardous for human being to come closer than 3m from a radiating antenna of 50W or more. Therefore, all antenna masts or structures carrying combined RF Power of 50W or more shall be enclosed properly by a suitable fencing and shall also be equipped by anti-climbing device. Fencing could be made of any kind and of any size so long as it prohibits unauthorized entry. A “Danger” sign placed on fence or closer to antenna would be an advantage to make aware the guests and family members of the house (if rented) from touching the antenna or coming closer to it.

2.14 Right to Inspect a Tower Structure by CAAN

It should be noted by TSP/IO that Civil Aviation Regulation of Nepal authorizes CAAN inspection team to enter and inspect any household without prior notice within the vicinity of an aerodrome, if a structural mast has been erected or adversely lighted on the roof-top without prior consent or approval from CAAN.

2.15 Environmental Issues

While constructing a mast or structure, TSP/IO should take into consideration of environmental issues and impact that a given structure may pose to the natural beauty of the city or to the world heritage site, temples, archeological establishments, etc. A prior approval from the municipality or concerned environmental institution must be in place prior to attempting to any such installation work.

2.16 Amendments to these Guidelines

Provisions made in these Guidelines could be amended by NTA time to time as and when required. Any such amendment would be notified to all TSP/IO.

2.17. Clarification

On any legal dispute or misunderstanding on the provisions of this guideline, NTA explanation or clarification would be the final and binding .

3.0 GUIDELINES ON RF RADIATION HAZARDS

3.1 Health Hazards from RF Radiation

With a view to minimizing health hazards caused by radiations from the base station towers, the service providers will have to follow anti-radiation norms while setting up their base stations. Most of the countries in SAARC region and around the word have adopted ICNIRP guidelines as standard. The ICNIRP guidelines were issued in 1998, which is still valid in the frequency range 100 KHz to 300GHz.Therefore, Nepal will also adopt the same norms for bringing antenna deployment criteria in line with best practices and to ensure the safety of technical personnel working on the towers in front of the antennas.

The ICNIRP guidelines declare the effect harmful only when a human being comes into direct path of an antenna radiating surface (mounted on top of the tower) within 3 meters (10 feet). Continuous exposure for a prolonged duration can cause harmful effects on human health. The effect reduces as distance increases and remains negligible at 8 meters (25 feet) and beyond. Therefore, it is presumed that the general public can in no way be exposed to the level of radiation that is harmful for human health due to the fact that such antennas are generally mounted on towers and rooftops more than 100 feet away from the road levels.

3.2 Safety Guidelines from Non-Ionizing Radiation

Based on safety guidelines, prescribed by ICNIRP, following recommendations are made to the telecommunications service providers. TSPs are strictly advised to adhere to these guidelines. It should be noted that Public Exposure is five times more stringent than those for the workers.

1. NTA will enforce and monitor the maximum RF power density at base stations with high power transmitters to ensure compliance of ICNIRP requirements.

2. TSPs are strictly required to adhere to ICNIRP norms as indicated in the guidelines. Summary of exposure limits in the frequency range 1 MHz to 300 GHz, for Public Exposure and the Occupational Exposure (Workers), are indicated below. It is advisable to keep field-strength records of each base station with self-certification and should be produced on demand by Public and NTA.

3. Security fencing and Danger signs must be placed at the base of the mast to prevent unauthorized persons from entering the radiation area. It has been measured that radiation within 3m from an antenna is more harmful.

4. Details of international recommendations on safety issues is attached in Annexure-VI of this document.

Occupational Exposure to Electric Exposure limits for and Magnetic Fields

Frequency	Electric Field (V/m)	Magnetic Field (pT)	Equivalent Plane Wave Power Density S_{eq} in mW/ cm^2
1-10 MHz	610/f	2.0/f	
10-400 MHz	61	0.20	1
400-2000 MHz	3√f	0.01√f	f/400
2-300GHz	137	0.45	5

Public Exposure to Electric Exposure limits for and Magnetic Fields

Frequency	Electric Field (V/m)	Magnetic Field (pT)	Equivalent Plane Wave Power Density S_{eq} in mW/ cm^2
1-10 MHz	87/√f	0.92/f	
10-400 MHz	28	0.092	0.20
400-2000 MHz	1.375√f	0.0046√f	f/2000
2-300GHz	61	0.20	1.0

f – As indicated in the frequency rang column

Questionnaires

Stakeholders/scholars/experts and any other interested parties are requested to kindly provide;

1. comments and suggestions on proposed "Guidelines on Erection of Antenna Structures" to be followed by the telecom operator/IO.

2. feedback on the Declaration Form to be filled up by the operator, Approval letter to be provided by NTA, completion report to be submitted to NTA. Do they include all the relevant and necessary parameters? If not, suggest.

3. opinion on the mandatory requirement of prior approval for the operator to install and operate the Radio Base station including the airport vicinity, archeological or national heritage area from the respective authority i.e CAAN , Municipality, NTA.

4. views on the proposed guidelines to be followed by the operators on electrical safety, design and erection criteria, height of the tower, coloring, obstruction light, fencing/warning signs, Lightning Protection mechanism, qualification of the fabricator, Visual Markings provision, Mast Lighting and Obstruction Lights.

5. comments on the proposed provision on necessity of NTA consent/approval on alteration to approved structure, removal of abandoned structure

6. feedback on the provision of Periodic Maintenance to ensure safety and integrity of the masts, Change of Ownership Notification/permission, appropriate provision for Security Fencing/Anti-climbing Device

7. comments on the proposed safety guidelines from Non-Ionizing radiation form the Radio Base stations. Is it sufficient for the RF safety from the base stations? If not provide your opinion to add/remove the parameters or other respective to be included on the guidelines.

8. any other relevant comment/suggestions on the proposed guidelines basically on procedure, and standards to be followed/adopted by the telecom operator and NTA.

Annexure- I

DECLARATION FORM FOR ANTENNA STRUCTURE/ TOWER INSTALLATION
(Please fill in one for each site)

1. General Information

1.1 Name of the Operator ---------- ----------

1.2 Corporate Address ----------

1.3 Name/Position and Contact Telephone of the responsible person

---

---

2. Site Details

2.1 Location ---------- District ----------

---------- VDC/Municipality ---------- Ward No.

2.2 GPS Coordinates ---------- N---------- E

Height above sea level ----------

2.3 Ownership: Company's property Rented/ Leased ☐

(In case of rented house or land, TSP/IO must have prior legal agreement between parties)

2.4 Is it located in World Heritage or in restricted area? Yes ☐ No ☐

If yes, provide authorization letter ---------- ----------

3. Technical Details

3.1 TSP/IO License No. ----------

3.2 Structure Type: Self Supporting Guyed ☐ Monopole ☐ ☐
Other

If other explain ----------

3.3 Height from ground (including building, if applicable) ----------

3.4 Antenna Type---------- Gain --------

3.5 Height above ground of lowest antenna ----------

3.6 Total number of channels----------

3.7 Effective EIRP per Channel in Watts ----------

3.8 Channel Frequencies

Up Frequency	Down Frequency
----------	----------
----------	----------

4. Sharing of Infrastructure

4.1 Yes ☐ No ☐

4.2 If yes, provide details of the operator ----------------- --------------------------------------

5. Structural design

5.1 Name and address of the designing firm/ engineer ------------------------------------

5.2 Name and address of the fabricator------------------- --

(Attach a copy of the certified structure drawing, if not similar to one of those submitted earlier)

6. **Location Map**

7.

8.

- -

Signed and sealed on behalf of the company Date

NEPAL TELECOMMUNICATIONS AUTHORITY

Annexure-II

Ref. No. Eng. – 06--/06--

Date ----------

Approval Letter

Approval No. ----------

To

This is with reference to your Declaration Form dated ---------- for approval and installation of antenna structure. You are hereby authorized to install the said antenna structure within the specified design and location as mentioned in the Form. Any alteration to specification or location must be reported to NTA immediately. Upon completion of structure and equipment installation works please forward a completion report to this office. With this you are advised to follow the "NTA guidelines on installation of antenna structure" and strictly requested to adhere to the specified limits.

.....
Authorized Signature with Full Name and Designation

Annexure-III

Erection/Modification of a Mast Structure
Completion Notification

Date ----------

Subject: Completion Notification

Dear Sir,

We hereby certify that construction of following mast/masts at location/locations specified below/in an attached list, have been completed.

Site Name ----------
Location in GPS Coordinates---------- N
---------- E
---------- AMSL

---------- ----------

Signed and sealed on behalf of the company Date

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CAAN Obstruction Guidelines

ICAO Annex-14 Chapter-4: OBSTACLE RESTRICTION AND REMOVAL

The following is a summary of recommendations made by the International Civil Aviation Organization (ICAO) to define the airspace around aerodromes to be maintained free from obstacles so as to permit the intended aircraft operations from becoming unusable by the growth of obstacles around the aerodromes. This is achieved by establishing a series of obstacle limitation surfaces that define the limits to which objects may project into airspace.

While erecting an antenna structure in the vicinity of an aerodrome TSPs must take note of the following:

1. For the purpose of defining the obstacles around the aerodromes, ICAO has classified various surfaces with different obstruction heights around the aerodromes by taking runway as the centerline.

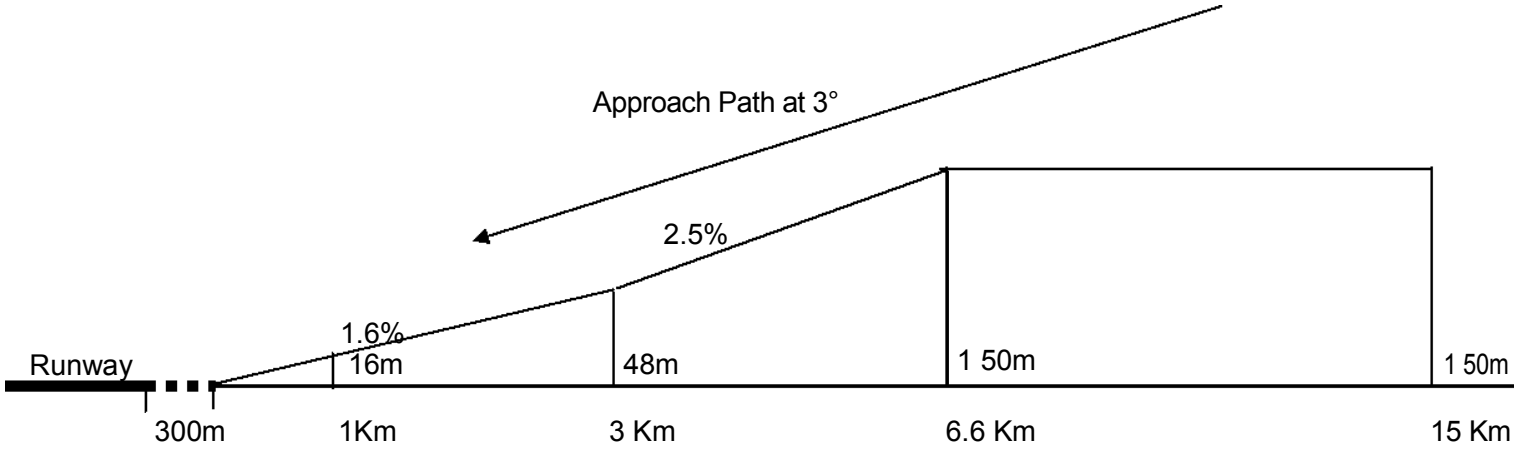
2. 15° left and right from the centerline of both ends of the runway fall under “Approach” or “Take-off Climb” areas. Therefore stringent obstruction criteria apply in these areas. TSP should exercise caution while designing a site in these areas and must get clearance from CAAN before making any decision. Any unauthorized installations in these areas shall be subject to penalty and dismantling of structure as per CAAN safety regulation.

3. Beyond “Approach” and “Take-off Climb” areas “Inner Horizontal” and “Conical” surfaces exit which are comparatively more relaxed from antenna erection points of view. Radius of “Inner Horizontal” surface is 4Km and the “Conical” surface extend 2 Km beyond it.

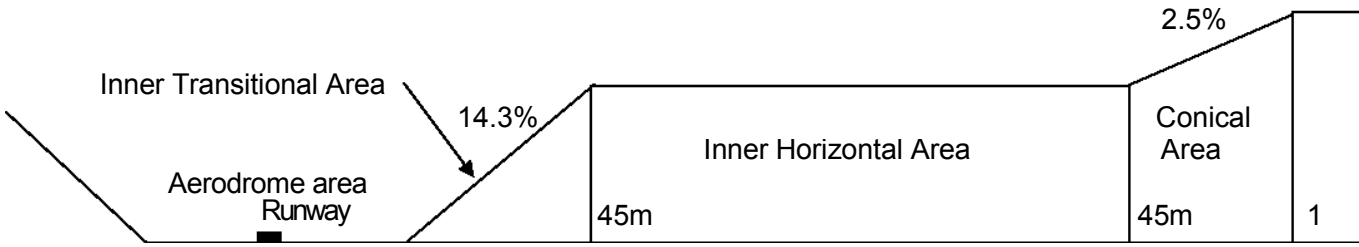
4. No telecommunication antenna installation, other than those meant for aviation, is permitted in the aerodrome areas, which include airstrip, inner approach and transitional areas.

5. Figures 4-1 and 4-2 provide general guidelines to TSPs on acceptable antenna heights from the ground level at various locations around an aerodrome. Height of the building must be added to antenna mast to calculate the overall height of an antenna.

6. TSPs are advised to plot the above surfaces on a 1:50,000 maps available from survey department to determine the position of the aerodrome so as to calculate acceptable height at a desired point. Heights indicated are for guidelines only and must be confirmed from CAAN.



(Fig. 1: Allowable obstructions at various distances on ± 15° from the centerline of the runway)


2.5%
Inner Transitional Area
14.3%
Conical
Area
Inner Horizontal Area
Aerodrome area
Runway
45m
45m
1

(Fig. 2 Allowable obstructions at various distances other than ± 15° from the centerline of the runway)

Lightning Protection and Earthing

General

Lightning is a random phenomenon, which may cause serious damages to human as well as to the property if precautionary measures are not taken beforehand. There is no known method of preventing a lightning. However, disastrous consequences may be significantly reduced by providing safe passage of discharge to the ground. This can be achieved by taking following three measures:

- Installation of a lightning arrestor
- Routing of the discharge to the ground through a down conductor, and
- Allowing dissipation of energy into the ground through proper Earthing.

Lightning Arrestor

The purpose of the Lightning Arrestor is to launch a successful "up-leader" higher than any other point on the antenna structure, thereby to guide the charges to dissipate through a safe passage onto the ground through a single entrance. Pointed rod on top of the mast is a popular type of arrestor that provides coverage upto 45° from its tip. Other types of arrestors are also available. TSPs/IOs are free to choose any appropriate arrestor of its choice.

Down Conductors

The purpose of the Down Conductor is to safely conveying the energy to the ground. It should be as short as possible without any sharp bends and stress that may reduce impedance of the conductor. A Down Conductor may be of copper, aluminium or galvanized steel. However, for better conductivity copper is recommended. It should preferably be a flat strip (Ribbon type) to increase the surface area or a multi-strand insulated cable.

Earthing

Proper Earthing play vital role in dissipating energy into the ground. For this a very good contact (low impedance) between the electrodes and the Earth is necessary. Therefore, the electrodes are needed to be buried so that they have large area of contact with the soil. Good Earthing therefore depends upon resistivity of the soil and use of appropriate grounding conductor. Resistivity of the soil varies greatly with the type of soil, temperature, moisture content, depth, additional material used for back-filling and size of the electrode. The following table shows ground resistivity vs. type of soil.

Soil Type	Resistivity Ohm/m
1. Marshy Ground	2 – 2.7
2. Clay	4 – 150
3. Chalk	60 – 400
4. Sand	90 – 8000
5. Sandy Gravel	300 – 500
6. Rock	> 1000

From the above table it is evident that grounding is solely dependent on soil conditions. TSP should make every effort to make the resistivity of the soil as low as possible. In many cases soil conductivity could be improved by adding salt, conductive carbonaceous aggregates (Charcoals) and moisture retaining clays by backfilling the electrodes. Earthing electrodes could be of several types, such as:

- Flat ribbon type conductors laid in horizontal plain in radial or ring form
- Long rod conductors driven into the Earth
- Large flat square or circular electrodes buried in ground

In any case, the ground electrodes should have low electrical resistance (copper, copper plated steel rods or galvanized plates, etc.) and ability to carry high currents repeatedly. Since it is impractical to dig the trench and keep changing electrodes every now and then, it is advisable to use pure copper rods or plates to avoid corrosion and serve for long time.

Minimum Earth resistance as per ITU specifications:

Description	Required Earth Resistance in Ohm
1. Switching installations upto 2000 subscribers 2. Switching installations > 2000 subscribers 3. Small Repeater Stations or BTS 4. Large Repeater Stations or BTS 5. Cabinets 6. Subscriber premises	5 0 2 0 4 0 0.5 0 5 – 10 0 20 0

It is a general practice to drive the copper plated rods into the ground pits to achieve above Earth resistance. If appropriate ground resistance is not achieved then It can be achieved, either through a single electrode, several electrodes laid beneath the earth surface in radial form, rings or mix of all. In every case all the ground electrodes and the down conductor must be bonded together at one point.

AC Power Lines

Distant lightning may induce high voltages in ac power lines causing surges. Most of the damages to the electronic equipment do happen due to surge from power lines rather than those from direct hit. Therefore, equipment need to be protected from surges and transients on incoming power lines. Therefore, TSPs should use “Surge Protective Devices (SPD) in the main power distribution board. Surge suppressors come in various forms:

- Shunt Type
- Fuse Type
- Circuit Breakers Type

The following specifications for SPD are recommended:

Characteristics	Recommended Values
1. System Voltage	230V
2. I_{max} (8/20 µS) Per Phase	60 kA or above
3. I_{imp} (10/350 µS) Per Phase	30 kA or above
4. V_{clamp} at I_{max} Per Phase	1.8 kV or below

General Recommendations for TSP/IO

Small Roof-top Antenna Structures

1. A proper Earthing must be done near the basement of the building with maximum Earth resistance measured under dry condition not to be more than 5Ω. It will be the responsibility of the TSP/IO to maintain this value throughout the year.

2. At least one ribbon-type copper down conductor, with total cross section not less than 50 mm^2 (2mm x 25mm), must be used. For better conductivity and to ensure safety of the building more than one conductor could be used.

3. While preparing the foundation of the structure, care should be exercised not to connect the building RCC rods to the antenna structure.

4. Adequate Surge Protective Device (SPD) should be installed in the main power cabinet and the entrance of antenna feed line.

Annexure -VI

International Recommendations on safety issues

There are fears amongst general public that mobile phone masts produce dangerous ionizing radiation that is hazardous for human being. Interaction of electromagnetic energy with biological materials, such as human cells, depends mostly upon source of the radio frequency. At extremely high frequencies, such as X-Ray, electromagnetic waves have sufficient energy to break chemical bonds of the cells, thereby damaging genetic materials of the cells leading to cancer or birth defects. Mobile phones and their base stations have much lower frequencies, i.e. from 800 to 2200 MHz, only. Therefore, their energy is relatively very low and produces non-ionizing effect. It does not harm like X-Ray. However, long-term effects have not been sufficiently studied. This does not mean that no safety guidelines should be reinforced.

Since X-rays are classified as ionizing radiation, its exposure is greatly regulated by the Governments and industries all over the word. Unfortunately, when setting guidelines for lower frequency products emitting VHF/UHF/Microwave radiation, industry only highlights thermal effect of radiation stating that body temperature would increase resulting in RF burn if over-exposed. The governing authorities also have not taken it very seriously. Federal Communication Commission (FCC) guidelines of USA outlines the power exposure levels permitted for public as $1mW/cm^2$ for 30 minutes exposure whereas for the workers it is set at $5mW/cm^2$ for 6 minutes. The rationale behind the difference in permissible exposure levels is that workers are well-aware of the presence of radiation and can protect themselves, whereas the public is considered unaware of radiation and would not take any precautionary measure.

The FCC RF exposure guidelines apply for non-ionizing part of electromagnetic spectrum and apply for devices such as mobile phones sets, wireless internet (WLAN) and mobile phone base stations or BTS. These regulations are based on, so called, Specific Absorption Rate (SAR). Although there is no question that the SAR measurement is important for establishing how much radiation is deposited in human tissue that generate thermal effect, but it ignores any possibility of biological effects from the magnetic field. Therefore, US Exposure Guidelines are universally not accepted in many parts of the world[1]. For example: Russian limits for RF radiation exposures are up to 100 times stricter than those in US and in Western Europe.

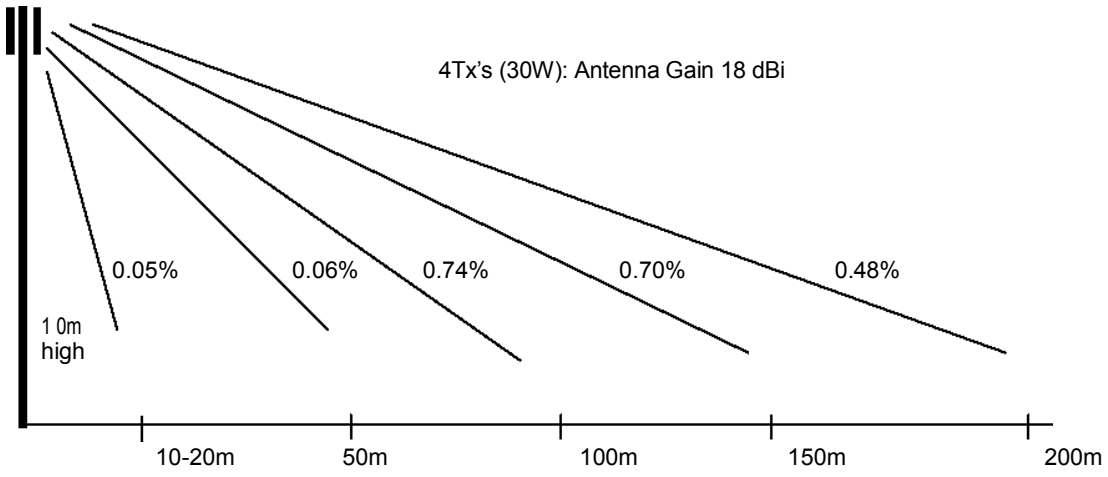
In January 2000, Swiss health and environmental officials adopted strict rules for public exposures from new sources of RF radiation. Switzerland has one of the most stringent guidelines in the world requiring power levels effectively 100 times lower than those of ICNIRP and ANSI. Austria's standard is also several times lower than FCC guidelines for RF base station radiation. In Canada, new policy would impose RF radiation limit on cellular base stations 100 times more stringent than the current Canadian Safety Code-6. There are no strict guidelines in India with regard to RF exposure. In Nepal too, there is no Governmental or non-Governmental agency involved in research work on biological effects of RF radiation on human being. The question of safety from wireless phone or mobile base station is still very unclear. Therefore, from public health perspective, it is critical for consumers to have the information they need to make an informed judgment about how much of the unknown risk they wish to assume in their use of wireless phone or remain within the vicinity of the BTS. However, one thing is clear that long-term exposure may have serious consequences. There are several

1 Wireless Devices, Standards and MW Radiation : Gary Brown, Nova Southeastern University

national and international safety guidelines exist on RF radiations and the principal guiding organizations are:

- Institute of Electrical and Electronics Engineers (IEEE)
- American National Standard Institute (ANSI)
- Federal Communication Commission (FCC)
- The International Commission on Non-Ionizing Radiation Protection (ICNIRP)
- The National Council on Radiation Protection and Measurements (NCRP)

ANSI/IEEE safety exposure standard for human from the mobile stations operating in 1800 MHz band is 1.2mW/cm^2 whereas for 900 MHz band it is 0.57 mW/cm^2. Exposure standards apply for power densities averaged over 30 minutes. It is mostly believed that exposure to RF radiation is hazardous if exposure is sufficiently intense leading to injuries like cataracts, skin burns, deep burns, heat exhaustion and heat strokes. Numerous research works have been done worldwide to evaluate the effects of RF radiations on human being. However, most of them contradict each other. It is assumed that children are more vulnerable to RF radiation than grown up people. Therefore, most of the research works are carried out in the school areas and amongst the children. A research conducted by Prof. J.E. Moulder from University of Wisconsin in some Canadian schools to evaluate exposure of mobile telephone radiation on children. The measurements indicated maximum radiation from an average base station within the vicinity of 60 to 300m and followed a pattern as indicated below[2].



(Field Strength near Mobile Phone Base Station)

A mobile phone base station with antenna at 10m high from the rooftop and operating at maximum power level upto 30-40W may produce 0.01 mW/cm^2 on the roof. However, in publicly accessible areas it will be in the range of 0.0001 to 0.0005 mW/cm^2 only as field strength reduces rapidly and is inversely proportional to square of distance. Power density inside the building will be even lower.

Therefore, it could be concluded that if antennas are mounted in such a way that public could not gain access to areas within 8 meters (horizontal) of the radiating surface, it could be considered as safe from radiation point of view. If antennas are mounted above 8 meters from

[2] Research Paper: 2004, JE Moulder, University of Wisconsin, USA

the roof then it may meet safety standard. Almost 20% children assessed in Canadian schools were found having exposure levels of 0.01% of ICNIRP standard.

RF Energy and Cancer

Numerous reviews and research works until 2005 conclude:

- In May 2000, the American Cancer Society bulletin stated: "No solid evidence yet exists regarding cell phones and cancer"
- Research has shown that exposure to RF/MW emissions from a transmission tower demonstrate significant differences in visual reaction time and reduced memory in students in a close-by school.
- Excerpts from October 7, 1999 report of Dr. Georg Carlo of Wireless Technology Research Group of USA indicate : "The rate of death from brain cancer among hand held phone users was higher than the rate of brain cancer deaths among those who used non-hand held phones that were away from the head."
- Exposure to low level of RF radiation may cause subtle biological effects. However, adverse health effects remain unproven.
- Localized exposure from mobile phones may induce effects as a result mild heating of superficial tissues close to head.
- Canadian study indicates that the effect of exposures from mobile phones is thousand times lower than the Canadian safety limits.
- While most studies have found few, if any, health risks from cell phones, research has not proven conclusively that cell phones are safe, particularly for children.

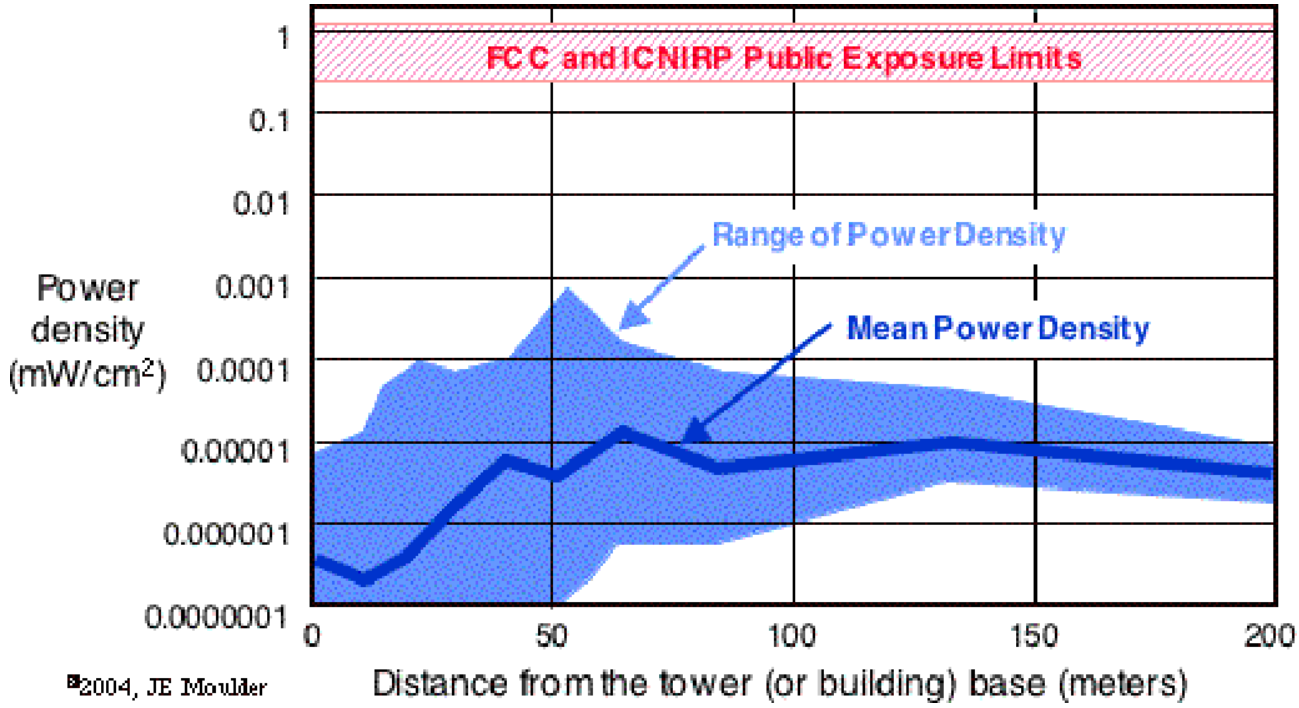
Conclusion

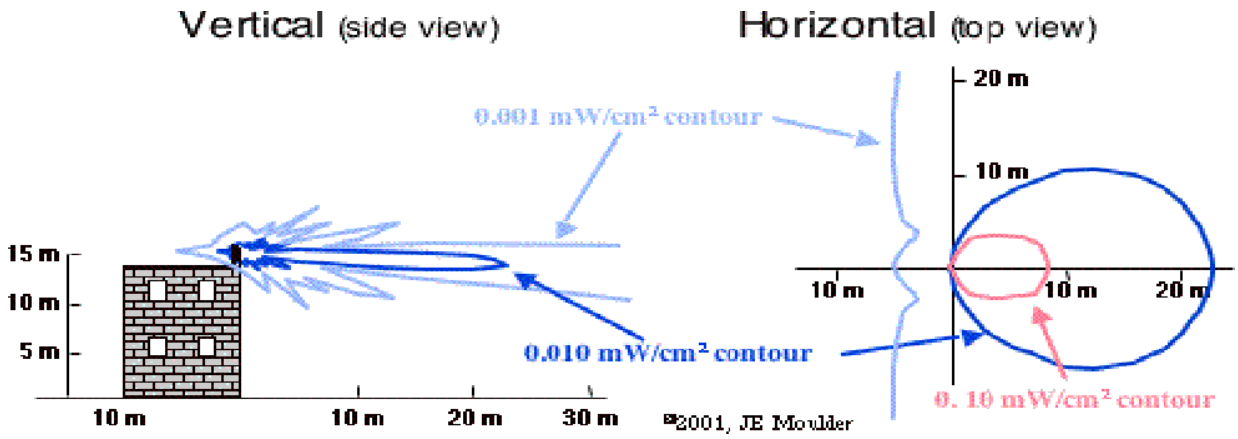
With a view to minimizing health hazards caused by radiations from the base station towers, the service providers will have to follow anti-radiation norms while setting up their base stations. Most of the countries in SAARC region and around the word have adopted ICNIRP guidelines as standard. Therefore, Nepal will also adopt the same norms for bringing antenna deployment criteria in line with best practices and to ensure the safety of technical personnel working on the towers in front of the antennas.

The ICNIRP guidelines declare the effect harmful only when a human being comes into direct path of an antenna radiating surface (mounted on top of the tower) within 3 meters (10 feet). Continuous exposure for a prolonged duration can cause harmful effects on human health. The effect reduces as distance increases and remains negligible at 8 meters (25 feet) and beyond. Therefore, it is presumed that the general public can in no way be exposed to the level of radiation that is harmful for human health due to the fact that such antennas are generally mounted on towers and rooftops more than 100 feet away from the road levels.

Estimated Radiation near a Mobile Phone Base Station

(Measured by J.E.Moulder in 2004 at a Canadian School)




Vertical (side view)
Horizontal (top view)
0.001 mW/cm² contour
0.010 mW/cm² contour
0. 10 mW/cm² contour
15 m
10 m
5 m
10 m
10 m
20 m
30 m
20 m
10 m
10 m
10 m
20 m
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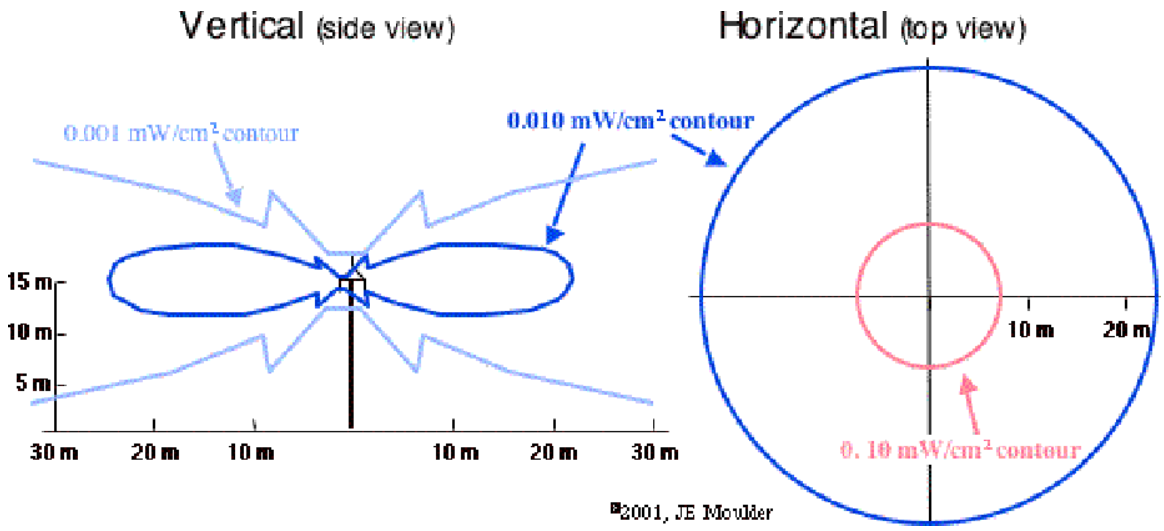
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15 m
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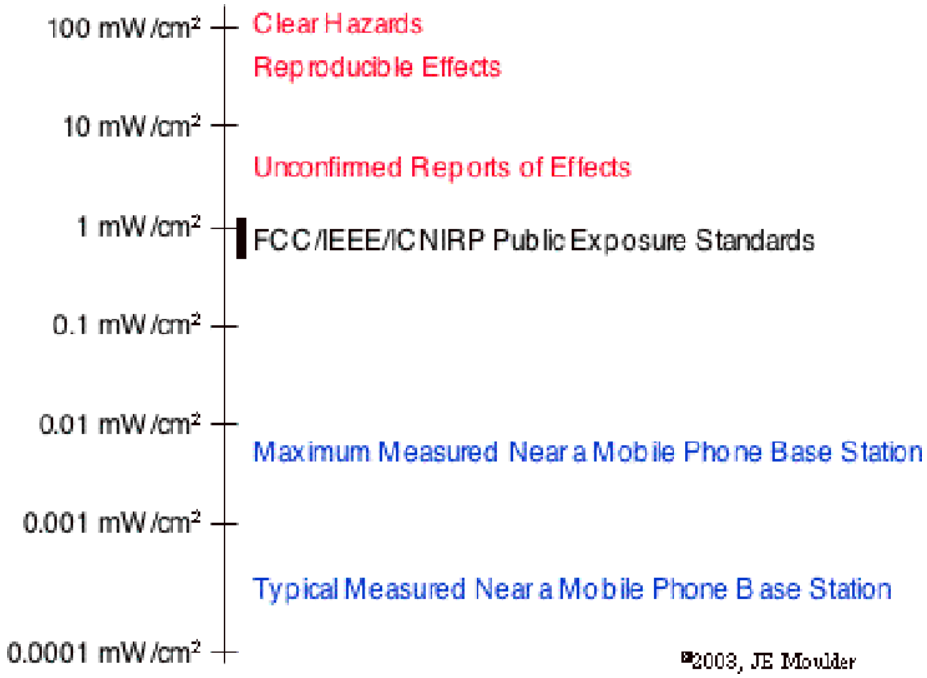
100 mW/cm²
Clear Hazards
Reproducible Effects
10 mW/cm²
Unconfirmed Reports of Effects
1 mW/cm²
FCC/IEEE/ICNIRP Public Exposure Standards
0.1 mW/cm²
0.01 mW/cm²
Maximum Measured Near a Mobile Phone Base Station
0.001 mW/cm²
Typical Measured Near a Mobile Phone Base Station
0.0001 mW/cm²
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